

CLAIMS

What is claimed is:

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1. A method of changing the temperature of a body housed in a heating chamber in a temperature controlled furnace from a starting to an ending set point temperature using a temperature control algorithm characterized in that:

said heating chamber houses one or more controllable heating elements, and one or more temperature sensing devices;

a set point temperature is accelerated from said starting temperature toward said ending temperature at a finite rate until a defined maximum ramp rate is achieved;

10 said set point temperature is substantially maintained at said maximum ramp rate until said ending temperature is approached;

said set point temperature is decelerated from said maximum ramp rate at a finite rate to said ending temperature; and

15 said temperature control algorithm substantially maintains the temperature of said body in conformance to said set point temperature.

2. The method according to claim 1 wherein said controllable heating elements are electrical heating coils.

20 3. The method according to claim 1 wherein said controllable heating elements are radiant heat lamps.

25 4. The method according to claim 1 wherein said temperature sensing devices are one or more thermocouples providing one or more temperatures for each of said one or more controllable heating elements.

30 5. The method according to claim 4 wherein a control temperature which is a mathematical combination of said one or more thermocouple temperatures is an input to said temperature control algorithm.

6. The method according to claim 5 wherein said control temperature is further defined to have a known offset from said thermocouple temperatures.

7. The method according to claim 6 further characterized in that said temperature offsets are static offsets that correct said control temperature for differences between the temperature of said body and said thermocouple temperatures.

8. The method according to claim 1 further characterized in that said body is a semiconductor wafer.

9. A temperature controlled furnace for changing the temperature of a body comprising:
a heating chamber housing one or more controllable heating elements, and one or more temperature sensing devices; and
a temperature controller configured to carry out the method of claim 1.

10. A method of changing the temperature of a body housed in a heating chamber in a temperature controlled furnace from a starting to an ending temperature using a temperature control algorithm comprising the steps of:

providing temperature data from one or more temperature sensing devices in said heating chamber and a temperature set point as inputs to said temperature control algorithm which controls power delivery to one or more controllable heating elements in said furnace;

accelerating said temperature set point from said starting set point temperature at a finite programmed acceleration rate until a defined maximum temperature ramp rate is achieved;

maintaining said set point temperature at said maximum temperature ramp rate until said ending temperature is approached; and

decelerating said temperature set point from said maximum ramp rate at a finite programmed deceleration rate until said ending set point temperature is reached such that the temperature of said body reaches said ending set point temperature smoothly without substantially overshooting or oscillating about said ending set point temperature.

11. The method according to claim 10 wherein said controllable heating elements are electrical heating coils.

12. The method according to claim 10 wherein said controllable heating elements are radiant heat lamps.

13. The method according to claim 10 wherein said temperature sensing devices are one or more thermocouples providing one or more temperatures for each of said one or more controllable heating elements.

14. The method according to claim 13 wherein said one or more temperature data inputs to said temperature control algorithm is a mathematical combination of said one or more thermocouple temperatures.

15. The method according to claim 14 wherein said control temperature is further defined to have a known offset from said thermocouple temperatures.

16. The method according to claim 15 further characterized in that said temperature offsets are static offsets that correct said control temperature for differences between the temperature of said body and said thermocouple temperatures.

17. The method according to claim 10 further characterized in that said body is a semiconductor wafer.

18. A temperature controlled furnace for changing the temperature of a body comprising:
a heating chamber housing one or more controllable heating elements, and one or more temperature sensing devices; and
a temperature controller configured to carry out the method of claim 10.

19. A temperature controlled furnace for changing the temperature of a body comprising:

a heating chamber housing one or more controllable heating elements, and one or more temperature sensing devices; and

a temperature controller configured to receive a set point temperature profile and temperature data inputs representative of said temperature sensing devices housed in said heating chamber and configured to vary power delivery to said one or more controllable heating elements such that the temperature of said body is ramped through a temperature acceleration phase, a constant ramp rate phase, and a temperature deceleration phase to achieve a desired temperature substantially smoothly with minimal oscillation around said desired temperature.

20. The furnace according to claim 19 wherein said controllable heating elements are electrical heating coils.

21. The furnace according to claim 19 wherein said controllable heating elements are radiant heat lamps.

22. The furnace according to claim 19 wherein said temperature sensing devices are one or more thermocouples providing one or more temperatures for each of said one or more controllable heating elements.

23. The furnace according to claim 22 wherein said one or more temperature data inputs to said temperature control algorithm is a mathematical combination of said one or more thermocouple temperatures.

24. The furnace according to claim 23 wherein said control temperature is further defined to have a known offset from said thermocouple temperatures.

25. The furnace according to claim 24 further characterized in that said temperature offsets are static offsets that correct said control temperature for differences between the temperature of said body and said thermocouple temperatures.

26. The furnace according to claim 19 further characterized in that said body is a semiconductor wafer.

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